

AN ANALYSIS OF CONSUMER CREDIT
NUMERICAL SCORING SYSTEMS AND
THE EFFECT ON MILITARY SERVICEMEN

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THESIS

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by

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ABSTRACT

The four objectives addressed were the description of credit scoring development, the identification of management uses and attendant disadvantages of scoring, an evaluation of the current and potential uses of scoring in banks and credit unions, and the determination of whether military servicemen are adversely affected by scoring.

The conclusions reached were that the advantages of scoring appear to especially outweigh the disadvantages for large volume lending institutions with access to computers. A survey of the country's 100 largest banks and 100 largest federal credit unions indicated an apparent slowing of scoring growth. A sample of automobile loans of active duty servicemen scored on the systems of two commercial banks and one credit union provided limited evidence that servicemen are not treated fairly by credit scoring.

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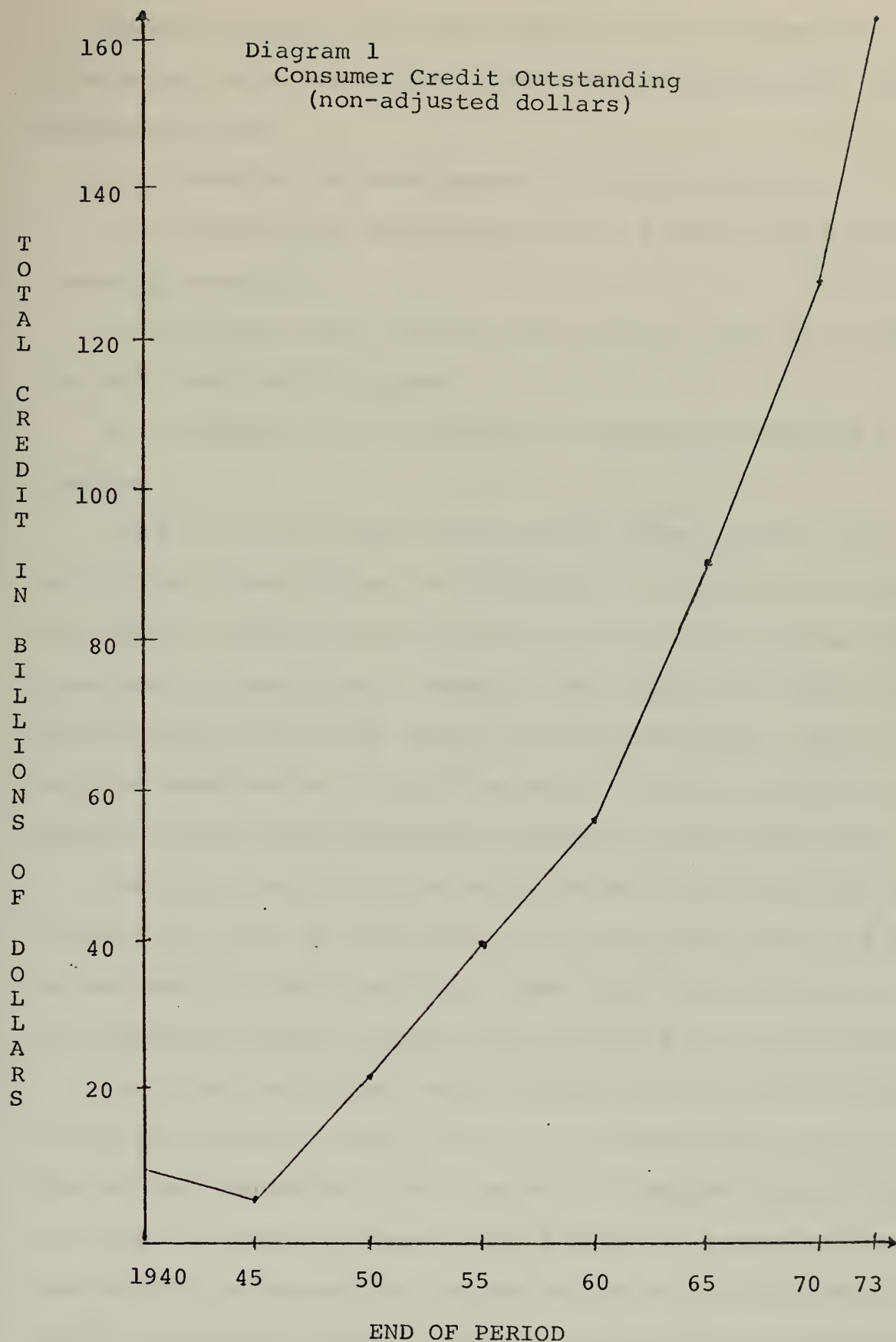
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I. INTRODUCTION

The growth of consumer credit has been steadily increasing since the 1920's and has shown a particular rapid increase since 1945. During the twenties and thirties, the purchase of automobiles by installments became popular. Sales Finance Companies sprang up and Banks began to establish large consumer loan departments. World War II caused a temporary lessening of consumer credit because of a lack of consumer goods. After the war, goods became more plentiful and several other factors changed. People began moving into urban areas, their discretionary income increased, and they began making increased demands for consumer goods. The stigma of buying on time was removed as more and more Americans became interested in "buy now, pay later" plans. Manufacturers were quick to realize that the increased demand for consumer goods was going to mean higher profits. They reacted by instituting wide sweeping advertising campaigns and other promotional techniques to insure that their products were known. Thus the desires of the consumer and the salesmanship of manufacturers combined to cause the growth of consumer credit. Diagram 1 tracks this growth from some \$8 billion in 1940 to over \$161 billion in 1973 [Ref. 1, Table A54]. This rapid growth has forced management methods to change in the consumer finance industry. New management techniques have been developed and old methods discarded. One of these new methods is the concept of credit scoring.



Certain aspects of credit scoring will be examined in this study while fulfilling four specific objectives. These objectives are:

- a. Describe the development of credit scoring.
- b. Identify the management uses and attendant disadvantages of scoring.
- c. Evaluate both current and potential uses of scoring in banks and credit unions.
- d. Determine if servicemen are adversely affected by scoring.

Part II of the study specifically addresses the first objective of describing the development of credit scoring. The authors define credit scoring and the factors that are involved in developing a system. The ideas that led to its conception and eventual growth are then explored. The sources of this examination included extensive library research and numerous field interviews with consumer credit personnel.

Parts III and IV of the study address the second of the objectives, that of identifying the management uses and disadvantages of credit scoring. Here again the primary sources of information were library research and field interviews.

The third objective, that of evaluating the current and potential usage of credit scoring, is addressed in Part V. The authors conducted a mail survey of the 100 largest banks and the 100 largest federal credit unions. Questions were designed to determine the degree of use of scoring among these groups and whether evidence existed demonstrating that

improved operations resulted from scoring. It should be emphasized that the authors limited their attention to bank and credit union use of scoring. Other users of scoring such as major credit card issuers, mail-order catalog companies, finance companies, and major retailers were not surveyed. The survey appears to indicate that use of credit scoring by banks is in a period of stagnation or perhaps decline. Because so few credit unions were found to be using scoring it is difficult to make a statement regarding its state of growth within these institutions.

The last objective, that of determining if servicemen are adversely affected by these credit scoring systems, is addressed in Part VI. A sample of good loans, bad loans, and turned-down loans of active duty servicemen was drawn from a small local credit union. This sample was then scored by the systems of two large commercial banks and one large credit union. The results were analyzed to test the hypothesis that servicemen are discriminated against by credit scoring systems. All of the sample loans were obtained for the purpose of purchasing an automobile. Automobiles now comprise approximately 40% of the total consumer installment credit outstanding. They are handled quite routinely and are a very profitable portion of a consumer lending institution's loan portfolio. Different types of loans can result in substantially different amounts of risk. To illustrate, a home improvement loan is less risky than a loan for a vacation or car repairs. By restricting the sample to automobile

loans these variations in risk for type of loan have been reduced.

A key factor in such a sample is the definition of "bad loans". Bad loans in this study are defined as loans that, at least once during the loan period, have been 60 or more consecutive days late in payment. This is a rather narrow definition in that such loans may still be quite profitable for the lending institution. Part VI discusses in depth the definitions and the sizes of the sample loan categories.

The results of the scoring of the good loans, bad loans, and turn-down loans of each of the three lending institutions are broken down into enlisted/officer and new car/used car categories. The analysis made of the results examines the acceptance and rejection of the good loan, bad loan, and turn-down portions of the sample. It also includes an overall test to evaluate which system does the best job of discriminating between the good and bad loans.

The authors then perform some sensitivity testing by varying the points allocated by the scoring systems on certain questions identified as being possibly adverse to the military servicemen. Another overall test of each system's ability to discriminate between the good and bad loans is conducted with the new scoring results that do not include the possibly adverse questions.

Each of the parts of the study addresses one of the objectives. Part VI provides limited evidence that servicemen are not treated fairly overall by credit scoring. It provides

an indication of areas or particular questions that tend to lower servicemen's scores in relation to the scores of civilian counterparts. The survey discussed in Part V indicates an apparent slowing of scoring growth among banks. The conclusions reached in Part II of the study indicated that the processing of large volume loan transactions has been considerably eased in terms of time and expense by the advent of the computer. The advantages of the uses of credit scoring would appear from Parts III and IV to outweigh the disadvantages for institutions handling an increasingly larger volume of consumer loans.

II. HISTORY OF CREDIT SCORING

A. WHAT IS CREDIT SCORING?

Credit scoring is a numerical method that quantifies the characteristics of loan applicants. Personal factors such as age, occupation, salary, previous credit dealings, along with other information appearing on the normal loan application are weighed and assigned points based primarily on loan repayment history experienced by the lending institution. The points are added and a single numerical value is determined. An example of a typical score sheet is provided in Appendix A. From the single numerical value the loan officer can make one of the following decisions: a) grant the loan with no further investigation, b) request further information, or c) turn down the loan. This chain of events is illustrated in the following diagram.

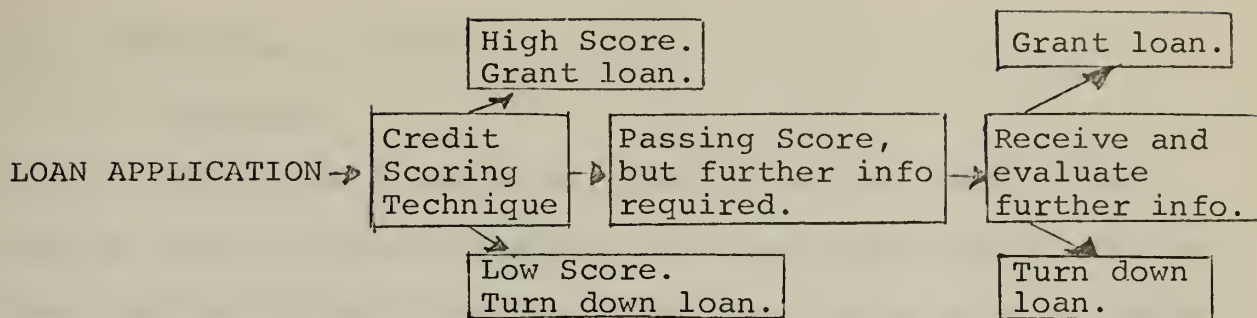


Diagram 2

By use of a scoring system loan personnel are better able to identify certain types of borrowers who are likely to become future collection problems. These people are normally turned down without further investigation. The system also attempts to identify those potential borrowers with outstanding credit characteristics. These people are normally granted loans with the bare minimum of further investigation (i.e., verify address and employment). Finally, the scoring system identifies people with those characteristics good enough to pass the scoring criteria but who do not have high enough scores to be granted loans with minimum investigations. This category of applicant can be further investigated by normal credit investigative methods such as contacting the local credit bureau for a credit report. It should be pointed out that scoring systems normally permit loan officers to occasionally override the score and grant credit to applicants with failing scores and refuse credit to applicants with high scores. Such action usually requires written justification.

B. DEVELOPING A SYSTEM

1. General

There are a number of statistical techniques that can be used to develop a credit scoring system. Systems have been devised through the use of multiple regression analysis, discriminant analysis, and Bayesian theory. Regardless of which method is used some combination of the following seven steps is normally followed:

- a. Based on his judgment and experience, have a credit man list those characteristics of a credit applicant that might be relevant to a decision.
- b. Have the credit man set forth an unambiguous definition of a good account and a bad account.
- c. Select a statistical sample of good accounts and bad accounts.
- d. Pull information relating to sample accounts from the file.
- e. Through statistical techniques screen out non-discriminating characteristics of sample information. Use those characteristics that discriminate to develop a risk index by assigning weights to each characteristic.
- f. Determine discriminating ability of the index for a sample of good and bad accounts. This can be done by actually scoring some good and bad accounts and then tabulating the results. An example of a risk index with an actual tabulation of good and bad accounts follows. (The index along with a thorough discussion of developing a scoring

system, appeared in a 1966 article in Credit World by G. J. Glasser [Ref. 2].)

<u>"Value of Index</u>	<u>Bad Accounts</u>	<u>Good Accounts</u>	<u>Total</u>
10-19.9	6	1	7
20-29.9	22	11	33
30-39.9	20	20	40
40-49.9	18	46	64
50-59.9	10	84	94
60-69.9	9	129	138
70 and over	<u>3</u>	<u>61</u>	<u>64</u>
	88	352	440"

g. Determine cutoff score rejection criteria on such bases as the average cost of accepting a bad account, the opportunity loss of rejecting a good account, and the relative frequency with which potentially bad accounts apply for loans.

The cutoff score is determined by finding the bad account probability where a decision-maker is indifferent to either granting a loan or turning it down. Cohen and Hammer [Ref. 3, p. 149] provide the following method for finding the indifference probability. Let p = probability of bad account, R = average return on good account, and L = average loss on bad account. Then at the indifference probability, $pL = (1-p)R$ which reduces to $p = R/(L+R)$. It should be pointed out that it is normally not an easy matter to determine the average loss or average return. Only by having

cost accounting procedures that report costs at a level of detail precise enough to include the expenses of writing delinquency letters, making phone calls on delinquent accounts, identifying collection expenses, etc., can an accurate determination of average return and average loss be made.

To illustrate the use of the formulas, suppose that the average return on a good account was \$20 and the average loss on a bad account was \$180. Solving for p we get:

$$p = R/(L+R),$$

$$p = 20/(180 + 20),$$

$$p = 20/200, \text{ which reduces to}$$

$$p = .1.$$

Hence the cutoff score would be that score where the probability of receiving a bad account was .1. In the above table the cutoff score would be between index value 50-69.9. This is true since 10/94 (probability of bad account in 50-59.9 range) equals .106 and 9/138 (probability of bad account in 60-69.9 range) equals .065. The point $p = .1$ is clearly somewhere between .065 and .106.

2. Requirements for an effective system

Besides being able to discriminate between potential good and bad accounts, a scoring system must have other attributes in order to be effective. The system must be capable of being easily updated and must be simple enough for operating personnel to understand. It should be able to provide management with controls over branches and other organizational sub-units. Finally, the system should provide an early warning of the accounts likely to become delinquent.

Because installing a credit scoring system is not an easy matter, a large number of users have management consulting firms develop and install their systems.

3. Obstacles in introduction

Large changes in day-to-day business operations such as going from a primarily subjective evaluation of credit risks to the more objective evaluation through credit scoring are not implemented without overcoming obstacles. Getting management to try credit scoring is sometimes hard. Once management gives approval, other obstacles are encountered in actual installation of a system.

Management initially may be of the opinion that installing a system will upset morale and that the credit staff may see the system as a threat to their job security. Although it is true that morale may suffer at the outset, experience has shown that after credit personnel become familiar with scoring techniques, they eventually consider these techniques as additional tools to assist them in their work.

The belief that the system is too complex for the credit staff to handle and that additional time and expense will be required is often voiced by management. It has been generally shown however that scoring is simple and can save time and expense. A more thorough discussion of the benefits and weakness of scoring appears in Parts III and IV of this study.

4. Cost

Having a credit scoring system installed normally costs somewhere between \$3,500 and \$50,000 according to a

1969 National Retail Furniture Association report [Ref. 4]. Current information provided to the authors by a consulting firm prominent in the credit scoring field indicated that the installation costs of most of the systems they installed were in the \$20,000 to \$30,000 range.

While the installation charges may appear insignificant to the large firm, the small firm may view them as prohibitive. The large firm may be able to quickly recoup the charges by increased efficiency in their operations (e.g., loan officers may be able to process more loans each day, credit bureau costs may be reduced, etc.). It may take a much longer time for the small firm to recoup its installation charges due to their limited volume of credit transactions. It would appear that scoring is not necessarily a good idea for firms of all sizes.

C. CONCEPTION AND GROWTH

Credit scoring is not a new concept. Although it is true that scoring has been extensively used only recently, its roots go back more than thirty years. The first published study dealing with this concept was by David Durand in 1941 [Ref. 5]. Durand analyzed hundreds of both good and bad loans from the files of commercial banks, finance companies, and industrial banking institutions. Through the use of discriminant analysis he developed weighting factors for these accounts and was able to predict good and bad payment results. In 1949 Wolbers did a study of a branch of a nationwide department store [Ref. 6]. He was able to show that credit

losses could be reduced significantly with little loss in sales volume. Reduction of credit losses by 20 percent with one 1 percent loss of sales volume was shown by McGrath in 1960 when he did a study for an automobile dealer [Ref. 7].

In the 1960's interest in scoring became widespread in the credit industry. This was evidenced by articles appearing in credit and banking periodicals and credit scoring systems becoming common place techniques in lending institutions. System usage spread from nationwide consumer finance companies to nationwide department stores, and finally to banks. Additionally, major oil companies began using these systems as did catalog sales companies. During the 1960's management consulting firms became interested in credit scoring and there are now a number of firms that actively seek clients desiring credit scoring systems.

D. REASONS FOR GROWTH

Credit scoring, like many other modern management science techniques, has grown primarily because of the increasingly recent widespread usage of computers. Such concepts as multiple regression analysis and discriminate analysis can easily be used to determine scoring weights through use of computers. It was not feasible to apply such techniques before the computer was introduced. The computer additionally can provide a wide variety of management reports resulting from credit scoring that would otherwise be too costly and time consuming.

Scoring has also grown because larger credit institutions have had to become increasingly more impersonal in their dealings with their customers. The impersonal relationship has been caused by the tremendous growth in the volume of credit and the high cost of administering a credit operation. To illustrate, major oil dealers and sales catalog companies both extend credit based on applications sent by mail. It is possible, and very often the case, that credit is extended without the customer and a representative of the firm ever engaging in face-to-face conversation. Banks have relationships with firms such as auto dealers and furniture and appliance stores in which they purchase sales contracts of customers who will probably never set foot inside the bank. Evidently it is either no longer possible, nor necessarily cost-effective for a credit officer to always size up the credit applicant through a personal interview. Scoring can assist credit granters in making decisions where no interview is possible since the concept is designed to use only the limited information appearing on a properly-filled-in credit application blank.

Administrative expenses connected with operating a credit organization have been rising. Salaries, rent, telephone expenses, and other costs have increased at such a rate as to necessitate economies in other parts of the credit operation in order to maintain the same profit margins. Scoring has been shown to reduce personnel costs, credit bureau expenses, and other administrative costs. A more thorough

examination of these savings is presented in Part III of this study.

In summary, the trend of impersonal business relationships coupled with the high cost of administering a credit operation has made credit scoring a concept that would appear to have potential for a promising future.

III. MANAGEMENT USES OF CREDIT SCORING

A. GENERAL

One of the strongest features of credit scoring systems is the fact that multiple management uses can be made from them. Not only are potentially good applicants selected and potentially bad risks rejected through scoring but the system also provides managers with data that can be used in other parts of the business. This study groups the management uses into six categories. In a discussion of these six categories scoring is examined as a decision-making tool, in credit control; in portfolio analysis, in training, in marketing, and in minor roles of a general nature.

B. DECISION-MAKING TOOL

Credit scoring is used by some firms as primarily a decision-making tool. To illustrate, decisions on whether or not to grant credit can be made based on a credit score. Further, scoring can be used to set time and dollar ceiling limits for credit cards, determine the amount of deposit required for establishing a home utility account, determine

credit investigation depth, determine the level at which credit decisions are made, and can be used to determine collection action for delinquent accounts.

1. Credit Authorization

The most widespread use of scoring is in the area of making decisions regarding the granting of credit. Using a score as a guide, a loan officer can easily weigh the risk connected with the transaction and quickly make a decision. This decision will hopefully result in the lending institution accepting that mix of applicants which maximize the firm's profit.

The credit manager has a trade off problem when making decisions regarding granting of credit. First of all, he does not want to authorize credit to those applicants likely to either default on their loans or will prove to be so expensive to administer that no profit will be made from the transaction. Additionally, he does not want to refuse credit to those applicants likely to be good risks and from whom a profit can be made. Hence, if the credit manager sets his credit standards too loose, bad risks will be granted loans. By the same token, if he sets his standards too tight, good business will be turned away.

Evidence has been gathered that substantiates the claim that scoring can reduce write-offs without adversely affecting total business volume. The National Retail Furniture Association (NRFA) special report on credit scoring previously cited indicated that several large furniture

chains had reduced bad debt write-offs through scoring [Ref. 4]. One of the firms was California based and reduced bad debt losses by one-half while reducing repossessions by 25-30 percent between 1960-1969. This was done in spite of the constant fluctuation of people moving in and out of California and loose bankruptcy laws. No information regarding the affect on total volume was given. In this same NRFA report, the controller of a midwestern furniture company reported that his firm had, in a 12 month period, reduced write-offs from \$40,000 per year to \$20,000 per year with a 1% drop in volume, by installing a credit scoring system. He emphasized that normally a \$20,000 profit increase takes \$400,000 in additional sales, assuming 5% return on net sales. Reducing the write-offs was probably a much easier task than promoting \$400,000 in additional sales.

The American Investment Company, a nationwide finance company operating from over 800 offices, reported a reduction in write-off expense after instituting their scoring system [Ref. 8]. They reported that at the same time industry write-off rates were rising, they had lowered their 1970 write-off figure by 20.2 percent when compared with their past rates. The write-off expenses were decreased during a period when AIC was growing in volume. This would appear to indicate that the reduction in write-off costs did not occur at the expense of total loan dollar volume.

The survey conducted as part of this study indicated that write-off expenses can be reduced through scoring.

Thirty-seven percent of the banks and two of five credit unions responding to the survey indicated that they had shown an improved loss ratio after instituting a scoring system.

As a decision-making tool scoring can also be used to increase total business volume. It does this by accepting a number of potentially good customers who would have been denied credit under past systems. Like most people, credit officers have their personal prejudices and these prejudices often result in denying credit to potential good customers. To illustrate, there was a recent case where a new credit manager, assigned to the Las Vegas district of a national department store raised the store's rejection rate because he frequently denied credit to employees of the gambling industry because of their occupation. Later when a scoring system was installed, it was shown that employees of the gambling industry were among the best credit risks. This example, borrowed from a 1969 Stores magazine article by Presby and Simon, [Ref. 9], demonstrates what can happen when decisions are made based on erroneous preconceived notions.

To summarize, credit scoring when properly used, can eliminate a significant number of potential write-offs without adversely affecting total business volume. This is because scoring not only identifies potential poor risks, it also identifies potential good risks who may have been denied credit under other methods of credit decision-making.

2. Credit Ceiling

The uniform setting of both credit dollar limits and time limits for repayment can be accomplished through scoring

use. The credit score indicates the relative amount of risk associated with a particular applicant as determined by the firm's history of prior customers with similar characteristics. Without scoring retailing firms frequently are overly conservative when initially authorizing credit, and tend to make the initial ceiling very low. This conservatism can result in lost sales. Sometimes the amount of the proposed transaction actually sets the credit limit. In this case a higher risk applicant is less likely to have a sufficient downpayment and may end up with a higher credit limit than a lower risk applicant.

A credit scoring system can provide a scale of credit risk from which credit limits can be assigned. Thus, the retailer is provided a standard from which to judge if the value of a particular transaction exceeds an applicant's ability to pay. He can also encourage sales by assigning low risk applicants high credit limits. Once the system is established new customers can easily be assigned credit ceilings. Later their payment records can be reviewed and the ceiling adjusted based on actual payment performance.

Scoring can also be used in determining time limits for credit cards. Those applicants with high scores can be issued the cards for extended periods of time, while marginal risks with low scores can be issued cards for more restrictive periods.

Another potential use of scoring in the area of decision-making is that of using scoring for determining amounts

of deposit for utility companies. Companies may not find it necessary for high scoring applicants to make deposits since little risk to the company is involved with this category of customer.

3. Extent of Investigation

Decisions regarding the extent of credit investigation required for applicants can be made through the use of scoring. Both outside credit bureau expenses and local investigation expenses are significant in most consumer credit operations. A concept that uses two cutoff scores can be used in determining the degree of credit investigation. Applicants scoring less than the low cutoff score are refused credit with no investigation while applicants scoring above the high cutoff score are granted credit after a minimum investigation such as a phone call verifying employment. Those applicants scoring between the low and high cutoff scores are investigated in whatever detail necessary when using this arrangement.

The extent of investigation can be a dynamic variable. There is a constant danger that once the borrowing public finds out that certain answers to questions mean the difference between receiving or not receiving credit, they may learn to lie intelligently on the credit application. This would result in applicants receiving credit that they would not have warranted if they had been truthful.

The problem of fraudulent application blanks with the likely increase in write-offs that would follow, is a matter

that must be considered before lessening the depth of credit investigations.

Several examples of saving investigation costs when using scoring can be given. Presby and Simon reported an elimination of one-half of the credit bureau costs of a large high-style department store in New York City after scoring had been implemented [Ref. 9]. The savings resulted from using better criteria that was gained through scoring to determine investigation requirements.

The American Investment Company reported that they estimated an annual savings of up to 125,000 hours in local investigation time after implementing scoring while the National Retail Furniture Association Special Report previously cited reported that one furniture finance company reduced credit bureau expenses by \$60,000 annually after implementing scoring [Refs. 10, 4].

Along with expense, credit processing time can also be reduced through scoring. Customers making large purchases such as TV sets or automobiles do not want to have to wait several days for credit approval. Processing time could be dramatically improved if a system could be devised that provided for near instant credit approval in a large percentage of cases. Obviously no system can be devised that will accept or reject instantly all potential borrowers. But it is possible to quickly isolate a good percentage of potential borrowers into two categories of good and bad risks where credit can be almost instantly granted or turned down.

The reduction of credit processing time is a major selling point of credit scoring and evidence exists that time has been reduced by scoring. For example, Boggess in a 1967 Harvard Business Review article reported that with a scoring system he examined that the average credit approval cycle time had been reduced from a week to 24 hours [Ref. 11].

In summary, one of the consequences of credit scoring is the reduction of credit investigation costs and time. This is accomplished by being more selective in asking for credit bureau information and by streamlining local credit approval processes.

4. Lower Level Decisions

Scoring can permit credit decisions to be made at lower levels in the organization. An experienced credit analyst's time is important and must be used efficiently. Besides making decisions regarding the granting of credit the analyst is also concerned with the examination of marginal accounts, with business and sales calls, and performing other managerial duties. Credit scoring frees the analyst from much of the time-consuming work of examining loan applications since a good percentage of the applications can be either turned down or approved by lower level personnel. As previously pointed out, the low scoring applicant can be refused credit based on his score. At the same time the high scoring applicant can be granted credit after a phone call verifying employment. Since these two categories of applicants can make up as much as 20-30 percent of customers,

the elimination of the need for an experienced analyst to examine their applications closely is of major consequence.

5. Collection Effort

No matter how hard management may try, they will never completely eliminate delinquencies or write-offs. Since these two sore spots will continue to be a part of the credit business for the foreseeable future, a continued attempt must be made to identify potential delinquencies and write-offs early, and then select the proper collection activity for each case.

Credit scoring can be used both for the early identification of high potential losses, and the selection of the best collection activity. Since those loans with the lowest scores are the most likely to be potential problems, they should receive the most attention in their early payment stages. Some sort of automatic review of low score credit transactions during the early payment stage can be made since scoring readily identifies these accounts.

If a loan is delinquent enough to be sent to the collection department, the fact that it has a score will give the collection manager some idea of what collection procedure he should use. Those delinquent accounts with high scores would normally get a gentle nudge in the initial collection effort while those accounts with low scores may require strong collection efforts from the outset. Obviously the score alone cannot direct collection efforts, but the score coupled with the manager's judgment should prove to be effective.

It would follow that scoring can help avoid the ill feeling of top quality customers who are often victims of overly intensive collection efforts when they are only slightly delinquent.

The use of credit scoring for determining collection effort has wide usage. Banks, credit unions, finance companies, and other lending institutions have indicated that they use scoring for this purpose.

C. CREDIT CONTROL

Credit scoring can pay important dividends in the area of credit control. Through scoring management can adjust credit tightness in a uniform manner, establish credit limits, exercise control over branch offices, appraise loan personnel performance and monitor dealer relationships.

The general arguments that uniformity and strict control may not always be desirable management objectives will not be addressed at any length in this paper. The degree of control that individual organizations wish to establish may vary from very strict to laissez faire. Regardless of what sort of control standards are evident, scoring provides management with at least the option of having degrees of strictness in their controls.

1. Credit Tightness

A problem constantly facing credit managers is that of adjusting credit tightness. There are times when management wishes to make credit more difficult and there are times when easy credit is desired. How does management convey its

wishes to loan officers in these situations? Simply telling loan personnel that credit should be loosened or tightened leaves the interpretation of this desire open to each individual loan officer.

Those firms which have a credit scoring system installed can easily and uniformly regulate credit tightness. When management desires to tighten credit, the cutoff score can be raised. By the same token, when credit should be eased the score can be lowered. By use of scoring, credit tightness is not only uniformly adjusted it is adjusted in a manner that insures that the firm continues to maximize profit. This is true because when the score is lowered only the best of the former bad risks are given credit. By the same token when the score is raised only the worst of the former good risks are denied credit.

2. Branch Offices

Communicating changes in credit policy to branch offices is normally a difficult task for headquarter's management to accomplish. The phrases "tighten up on credit", "loosen credit", "too many marginal loans are being granted", mean different things to different people. Instructions such as "lower the cutoff score from 30 to 28", "raise the cutoff score from 25 to 27", "your average score per dollar loaned last month decreased from 28.6 to 28.2", are a lot more meaningful and will stand a good chance of being interpreted uniformly in the field. Lowering a cutoff score from 30 to 28 or raising a cutoff score from 25 to 27 means the same thing

to each branch manager. Likewise telling a branch manager that he is loaning out money to more risky applicants than before is easily communicated by telling him that his average score per dollar loaned has decreased. Uniform understanding of instructions coming from headquarters is essential in large lending operations with many branches involved.

The easing of credit restrictions at one branch and the raising of restrictions at another branch is sometimes desired. For example, when write-offs are high in a branch, management may want to raise the cutoff score while in those cases when write-offs are below average and loan volume is low in relation to potential, the cutoff score should perhaps be lowered. Scoring provides for easy communication of such changes from head offices to the various branches concerned.

Several examples of scoring being used in branch control operations can be given. The First Pennsylvania Banking and Trust Company reported favorable results in this area. Scoring was providing management with reports that gave detailed information covering the overall performance of every office, every region, and every individual branch lending officer [Refs. 12, 13].

The application of scoring for branch control in multi-branch furniture chain operations has been reported [Ref. 4]. Scoring appeared to be an answer to the problem of delegation of authority for granting credit and setting limits, according to the report.

3. Performance Appraisal

Evaluating the performance of individual loan officers is at times a difficult thing. Should they be measured on the basis of the number of bad loans they approved? The profit they generated for the firm? Their total loan dollar value? All these measures have problems associated with them. If a loan officer is criticized for the number of bad loans he grants, he may become overly conservative. If he is graded based on the total profit he generates, those loan officers at the best offices will receive higher marks than those at the poorer offices. Finally, if he is graded on the basis of total dollar value of loans granted he may be prone to accept too many poor risks.

Through credit scoring some of the above problems can be overcome because scoring helps in isolating bad credit decisions. When loans go bad where the applicant clearly had a passing score, the loan officer should ordinarily not be criticized. On the other hand when loans go bad on applicants, who in spite of failing scores were granted loans, criticism is often appropriate. As was previously pointed out, most scoring systems provide for granting credit to applicants with failing scores and turning down of credit to applicants with passing scores, but only with some written justification.

It can be seen that by reviewing the written justification offered by loan officers a manager can get some feeling regarding their performance. In short, he can tell which

loan officer is using the right reasons for turning down or approving loans that go counter to the scoring system.

When First Pennsylvania Banking and Trust Company first implemented credit scoring some surprising early results were seen [Ref. 13]. First Pennsylvania's first delinquency report under credit scoring indicated a total of 16 past due accounts and that five of the 16 accounts had been approved by the same loan officer. To make matters worse all five had been approved despite failing scores. Examples such as the above readily demonstrate the value of credit scoring and its associated reports in highlighting unsatisfactory performance.

4. Dealer Relationships

It is common practice today for sales finance companies and banks to have relationships with such organizations as automobile dealerships and furniture stores in which the lending institution buy sales contracts from the retailer. Loans under this form of operation are called indirect loans. The relationship works as follows. A customer buys a product such as a car and desires financing. The auto dealership has the customer apply for credit by filling out a credit application and by completing a sales contract. The sales contract is subsequently sold to a sales finance company such as the General Motors Acceptance Corporation or to a bank. The sales finance company or bank has previously agreed to buy all dealer paper under certain conditions. The customer is then sent a payment book, the lending institution

picks up title to the auto, and the customer sends in payments to the bank or finance company, not to the dealer. In most cases the lending institution never sees the applicant in person and for that reason no credit interview is performed by the lending institution.

Credit scoring can be very helpful in the dealer relationship area. Since no interview is performed, and since the sales contracts are many in number and are handled on an assembly line basis, credit scoring has obvious benefits. Loans can quickly be scored and can be acted on without interview. Additionally, costs are reduced since decisions are made on the basis of a score computed by a low-salaried clerk. High level management action is required only in non-routine cases.

The actual granting of the loan is not the only area in the dealership operation where credit scoring is applicable. Better control over the dealer can be had through scoring by raising the cutoff score for those dealers who have high delinquency rates, and by lowering the score for low delinquency dealers. It was often difficult to make a decision regarding discarding a dealer when experience indicated a continuing high delinquency rate. Often the dealer was discarded too early after his delinquency rate became unsatisfactory. A better decision than dropping the dealer would be to raise his cutoff score gradually until satisfactory delinquency rates are reached. If problems continue, then clearly the dealer would have to be dropped.

To summarize, dealer control is an area where scoring can be used to produce significant results. Dealer performance can be easily monitored and prompt action can be taken where warranted. Control of this nature is not readily available without scoring.

D. PORTFOLIO ANALYSIS

The quality of a lending institution's consumer loan portfolio is constantly changing. The change is difficult to analyze inasmuch as thousands of loans are involved and there is often no provision for measuring the changing degree of risk for the mix of loans.

By scoring and assigning a single numerical figure to each loan, the current quality of the portfolio can be appraised. It can be appraised by month, by branch, by geographic area, or by total portfolio. One can, for example, compute the average dollar score for loans in total. It is important to note that the average score per applicant is not a good measure of portfolio quality since applicants borrow different sums of money. A simple example provided by Johnson in Ref. 14 will illustrate the difference between the average dollar score and the average applicant score.

<u>Applicant</u>	<u>Score</u>	<u>Loan</u>
No. 1	90	\$1,000
No. 2	60	\$2,000
Average score per applicant:		75
Average score per dollar:		70

As can be seen from the above illustration, although each applicant averaged a score of 75 ($150/2 = 75$) the average dollar score was only 70, $\{(90 \times 1000) + (60 \times 2000)\} \div 3000 = 70$.

If the average score in the above example later dropped from 70 to 65 for example, an indication of lower quality loans being accepted would be apparent. By the same token if the average score showed a significant increase, it would indicate that loan personnel were getting overly conservative. The factor of money availability must be examined also when evaluating the change in average score per dollar. Obviously an increase in score per dollar could be due to the non-availability of money to loan, and not due to conservative action on the part of individual loan officers.

Without credit scoring management has little basis for evaluating the quality of a loan portfolio. Loss ratios show some indication of quality, but this information is normally after the fact, and does not show current quality.

To further amplify this point an example can be given. Suppose a customer who eventually ends up as a write-off receives a loan on 1 January in spite of having a low score. By 31 January his score's adverse affect on the loan portfolio quality is already evident since the score and dollars loaned are now part of the amounts being used to compute the average score per dollar loaned. Without scoring no affect on portfolio quality would be shown until an actual loss was recorded on the lending institution's records which would

only occur after a considerable time period had elapsed. This may be two or three years in the future depending on when the customer stopped paying and the length of time collection efforts were being made.

E. TRAINING

Credit scoring can be very useful in training new loan personnel. The score card itself has useful information since it points out the important characteristics of credit applicants, gives the relative weights of the characteristics, and indicates total criteria needed in order to qualify for credit. During the training period a trainee's decision made without benefit of a score card can be compared with results of a scored application. In those instances where the trainee made a poor decision, the score card quickly points out the reasons for the poor decision.

Several institutions have reported using scoring as a training aid. Both the First Pennsylvania Banking and Trust Company and the First National Bank, Boston, Mass. are among those using scoring in their training programs [Refs. 12, 15].

F. MARKETING

Marketing efforts by lending institutions are both important and costly. New business is constantly being sought through newspaper ads, TV commercials, direct letter writing, etc. Having marketing information available on present and past customers can be helpful in a marketing effort. Credit

scoring, especially when used with electronic data processing equipment, can easily provide profiles on present and past customers since the answers to questions on the loan application give important personal characteristics. For example, when sending direct advertisements to customers through the mail it is desirable at times to contact only certain categories of customers such as only low risks, only home owners, only married men under 30, only people in certain occupations, etc. If the information that is scored is made part of a data base, one can see where it is a simple matter to extract marketing information from the data base when needed.

Scoring can be used to develop new markets. A bank may be experiencing a large number of turndowns and low loan volume in certain geographical areas. This could indicate a deficiency in the scoring system for the people located in these areas. One of the possibilities for increasing the bank's share of the market without making specific changes to the scoring system is to lower the cutoff score at the branches involved. Hopefully, the long run effects of repeat business from good customers gained, will offset short term losses incurred from acceptance of the higher risk applicants.

Evidence of firms using scoring as a marketing aid exists. The American Investment Company uses scoring in a marketing sense by encouraging their loan personnel to make larger loans to low risk applicants [Ref. 8]. The First Pennsylvania Bank and Trust Co. has used scoring in their marketing program

by soliciting business from past customers who were low risks [Ref. 13].

G. MINOR USES

There are several minor uses of scoring that for the sake of completeness should be discussed. Scoring can insure that application blanks are fully completed, can make it easier to predict losses, and can be used as an explanation for refusing credit.

1. Completed Blanks

Credit scoring has been shown to assist management in insuring that credit applications are fully completed. It has been shown that many application forms at lending institutions using non-scoring credit decision-making methods are not fully filled out. Often missing information is ignored since it is not absolutely essential for decision-making. Past studies have shown that applications for loans that are granted and subsequently written off have a higher tendency to be incomplete than do applications for loans that are granted and repaid [Ref. 16]. This is probably due to the fact that in the case of the write-off, the loan officer made his decision with incomplete information because the applicant either intentionally or unintentionally left out unfavorable data. Scoring eliminates the problem of incompleteness because it is normally not possible to compute a score with missing key information.

2. Prediction of Losses

It has been shown that scoring can make it easier for management to predict losses. This is because scoring stabilizes the loan portfolio by not allowing periodic increases in bad loans. Additionally, scoring gives management quantitative data for predicting losses by measuring the risk associated with each dollar in the loan portfolio. These authors, while doing the research for this paper, were shown reports of detailed loss predictions made by a large commercial bank through the use of scoring. Management personnel at the bank reported that the ability to predict losses was an extremely valuable by-product of credit scoring. No evidence verifying the accuracy of the predictions was presented by the bank.

3. Credit Refusal Explanation

Some users of credit scoring have found that it is much easier for loan personnel to turn down loans, and it is easier for applicants to accept the fact that they are not eligible for credit, when the reason for turndown is a failing score. With a certain amount of confidence the loan officer can explain to the customer that he did not meet minimum credit standards that are the same for everyone. Under non-scoring systems it is much harder for the loan officer to cite reasons for the turndown since normally there is no single reason, but instead the cumulative effect of several unfavorable characteristics causes refusal.

IV. DISADVANTAGES

A. GENERAL

The credit scoring concept is not without disadvantages. The disadvantages can be broken down into major and minor categories. Those of a major category include the fact that a scoring system must be continuously updated and the fact that most lending institutions need more than one system. Shortcomings of a more minor nature are those such as morale problems resulting from implementing scoring; information on applications being difficult to verify; certain categories of people having unusual difficulty in receiving passing scores; and systems not being founded on correct statistical populations.

B. SYSTEM REQUIRES CONSTANT UPDATING

Even the strongest supporters of scoring admit that scoring systems must be updated periodically. A reasonable time period between updating is on the order of three years, although the update period has been known to fluctuate from 6 months to 10 years depending on the company. The systems require updating because they lose their discriminating ability after several years. Types of customers may change, salaries for certain occupations may change, and a whole host of other reasons make it necessary to periodically update a system. The update costs approximately one-half the cost of setting up an initial system, so this cost could approach \$25,000 depending upon the type of system being used.

The significance of changing weight factors was illustrated by Boggess [Ref. 11]. The changes he illustrated were experienced by a system that a retailer (Company X) had used. Company X's experience was as indicated below:

"CHANGES IN COMPANY X'S CREDIT SCREEN 1964-1967"

<u>Characteristics of applicant</u>	<u>Credit rating points allowed</u>			
	<u>1964</u>	<u>1965</u>	<u>1966</u>	<u>1967</u>
Is married	7	8	8	10
Owens his home	20	16	15	15
Owens his auto	7	4	9	7
Age is 35 or over	9	9	8	11
Has lived at least 3 yrs at present address	13	18	15	14
Has a bank reference	26	20	21	18
Has a telephone	6	9	6	6
Has fewer than 3 children	<u>12</u>	<u>16</u>	<u>18</u>	<u>19</u>
	100	100	100	100"

Company X updated their system every six months by extracting a sample from accounts 9-15 months old. These accounts were categorized as good or bad, and new weighting factors were computed based on payment history experienced with the sample. As can be seen from the above, changes do occur that are significant. For example the weight of owning a home which in 1964 was 20 points, dropped to 15 points by 1966. The characteristic of having fewer than three children increased from 12 points in 1964 to 19 points in 1967. From

the above one can see that systems can lose their discriminating ability over time.

C. MORE THAN ONE SYSTEM REQUIRED

The other major disadvantage of credit scoring is the fact that more than one system is normally required. To illustrate, a commercial bank would normally require, as a minimum, separate systems for the following types of loans: direct auto, indirect auto, direct cash, and household improvement. Theoretically, in addition to the previous breakdown, an organization could have a separate system for each branch office plus a separate system for new and old customers. It is apparent that the entire concept becomes unworkable if separate systems are required for different types of loans, different branches, and different customers. Normally a compromise is reached and an organization has a separate system for each type of loan and disregards the location of a branch and the type of customer being scored.

Although the most popular way of categorizing scoring systems is by type of loan, there are a number of organizations who also have separate systems based on geography. This is especially true of nationwide firms who operate in most of the 50 states. For example, the American Investment Company has seven different scoring systems based on geography [Ref. 8]. As further evidence, the authors of this paper were told by one management consultant that one large nationwide department store chain had 38 different systems based on geography, type of customer, and type of account.

Since each separate system must be developed completely independent of any other system, the costs connected with having many separate systems can be a major disadvantage to some firms.

D. MINOR DISADVANTAGES

The morale of loan personnel can suffer when credit scoring is implemented. As previously pointed out many experienced loan officers feel that scoring will replace their judgment and as a result feel that their security is threatened. Based on ten years of observation of scoring, Roy and Lewis report that the judgment substitution problem, though frequent, is normally overcome once loan personnel see how scoring works and find out that it is simply another tool for their use [Ref. 17].

The scoring system is only as good as the information that appears on the loan application blank. As previously discussed, there is a danger that as the borrowing public becomes more familiar with scoring concepts that an increase in fraudulent applications may result. Verifying all information on each application is normally not a feasible answer to the fraudulent application question. Management is left with a problem that has potential serious consequences.

It has been argued that certain categories of people have extraordinary problems getting passing marks on scoring systems. People who move a great deal and young people just starting out in life have problems because most scoring systems heavily penalize applicants who are not stable or who

have no credit history. An entire section of this paper is devoted to this problem so it will not be further discussed here.

There are some credit experts who feel strongly that credit scoring cannot be reliable because they claim that the proper questions are not asked. Robert W. Johnson of the National Commission on Consumer Finance felt that the regular credit application form should include questions such as: Do you carry life insurance? Are you borrowing on it? -- how much? [Ref. 18]. The question of an applicant's alcoholic habits may also be important since the Commission had found that loans made to alcoholics involved significantly higher losses than loans made to the overall general population. Getting information regarding a person's alcoholic habits is admittedly not easy, but may be worth the effort when large amounts of money are involved.

Many scoring schemes are not based on sound statistical information. That is because the bad and good loan samples used in computing weights for the system are drawn from a population of customers who were all granted credit. Information on rejectees is normally not included. Since data computed only from customers previously accepted cannot normally be validly applied to customers in general, it can be argued that scoring systems formed on accepted customer data only, do not apply to the entire population of potential credit customers. Unfortunately there is no way of getting experience on rejectees because they are refused credit and hence

no one knows what percentage of them would have eventually turned out bad or good. All applicants could be accepted for a trial period and then experience could be obtained for all customers. This concept is completely unworkable however, because during the trial period write-offs would probably rise at an unsatisfactory rate.

Getting experience on both accepted and rejected applicants is a problem not easily solved. Fair, Isaac and Company have claimed a major breakthrough by developing a method that they feel overcomes this problem. An article appearing in a recent copy of Stores magazine pointed out that a solution had been found which enabled the credit grantor to apply the scoring system correctly to the entire population seeking credit [Ref. 19]. This breakthrough could be of major significance in the field of credit scoring. Unfortunately, the article did not give any details regarding the nature of the new technique, thus the validity of the claim cannot, at this time, be verified.

V. SURVEY RESULTS

A. GENERAL

Questionnaires were mailed directly to the 100 largest U.S. commercial banks and the 100 largest federal credit unions, ranked in terms of total assets, asking for information regarding the use and operating results of scoring. The questionnaire with forwarding letter is included as Appendix B.

B. BANK SURVEY RESULTS

Sixty-five of the 100 questionnaires were returned and found acceptable for use.

<u>Description</u>	<u>Sample Size</u>	<u>Number Using/Reporting</u>	<u>%</u>
1. <u>Category of Use</u>			
Loans of some type	65	24	37
Direct Auto	65	21	33
Indirect Auto	65	15	24
Household Improvement	65	19	30
Personal Loans	65	21	33
2. <u>Evidence of Actually Experienced Improved Operations</u>			
Improvement in general	24	13	54
Loss ratio	24	9	37
Delinquency rate	24	10	42
Reduction of admin expense	24	1	4

As can be seen from the preceding tabulation, 37% of the banks returning the questionnaires were using credit scoring. This compares with 35% use found by Wilt and Tierney in their 1967 survey of the 200 largest banks [Ref. 16]. A comparison of the two surveys would indicate a modest 5.7% growth in scoring use for banks between 1967 and 1973.

A wide variety of loans were being scored by the banks returning the questionnaires. Some banks used systems for scoring all types of consumer loans. Other banks scored direct auto loans, but not recreation vehicles or boats. A wide combination of uses was apparent, ranging from scoring all consumer loans to scoring only one type. Types of credit transactions being scored at banks included: credit card issuance, revolving credit approval, approval of overdraft line of credit used in conjunction with checking accounts, and the issuance of many types of loans such as school loans, land development loans, and mobile home loans.

It was also apparent that some institutions had a separate system for each type of loan, while others had a single system applicable to all consumer loans. Several banks sent the authors copies of their scoring systems complete with instructions for use. Although each system asked basically the same questions, there was widely different proportional weights placed on the same answer to a question. For example, having a telephone could receive as high as 15% of the maximum score in one case, while receiving less than 5% in another case. The survey also indicates that there is substantial

evidence of improved operations by banks using scoring. Fifty-four percent of those using scoring reported improvement in general. More specifically, 37% had experienced a drop in their loss ratio; 42% had experienced a reduction in their delinquency rate; and 4% had experienced administrative cost reductions attributable to scoring. In addition to the 13 banks reporting some improvement, there was an additional 9 reporting that, although no concrete evidence had been accumulated showing that scoring had improved their operation, nevertheless felt improvement had occurred. The fact that no concrete evidence existed was possibly due to the fact that some of the institutions had only been using scoring for short periods, or that their cost accounting system did not gather the detailed information necessary for a determination of concrete results. In any event, of the 25 banks reporting the use of scoring, 22 reported that operations had improved as a result of having a credit scoring system.

As expected, the length of time that banks had been using scoring also varied widely. The longest period any bank had used scoring systems was 14 years. The shortest period was less than a year. The average length of time was slightly over five years. It should be pointed out that the year figures in the previous sentences refer to the time period for using scoring in general and do not refer to use of a single system.

Of the sixty-five returning the questionnaires, seven (11%) reported that, although not having a scoring system in

use at present, they were considering them. This compares with 33% considering a system in 1967 when Wilt and Tierney did their survey. The reduction in the percentage of banks considering installing scoring since the 1967 survey may be because of firms initiating systems and then dropping them for some reason. The fact that 14 of 65 banks returning the questionnaire stated that they currently were not using scoring after previously trying it lends credence to this idea.

Although the questionnaire did not specifically ask for reasons for dropping systems, several bank officials gave reasons anyway. One institution reported that they had used scoring for one year and since no improvement in operations had occurred, quit using the system. Another bank official stated that they had tried scoring and found it to be a complete waste of time, money, and effort. Still another bank official reported that his bank had quit the regular use of scoring, but had retained their system to score loans after the fact in order to observe trends.

It was also reported that a bank's local research effort had shown that scoring, while beneficial for training, was not necessarily a good decision-making tool. The results of the local research effort lead to the bank dropping their system for decision-making purposes.

C. CREDIT UNION SURVEY RESULTS

Seventy-three of the 100 questionnaires were returned and found acceptable for use.

<u>Description</u>	<u>Sample Size</u>	<u>Number Using/Reporting</u>	<u>%</u>
1. <u>Catagory of Use</u>			
Loans of some type	73	5	7
Auto	73	4	5
Household Improvement	73	3	4
Personal Loans	73	3	4
2. <u>Evidence of Actually Experienced Improved Operations</u>			
Improvement in general	5	3	60
Loss ratio	5	2	40
Delinquency rate	5	3	60
Reduction of admin expense	5	3	60

As can be seen from the above table, only 7% of those credit unions returning the questionnaires were using scoring. An additional 19% reported that they were presently considering a system. The limited use of scoring when compared with banks can probably be attributed primarily to the small size of most credit unions. Furthermore, they do not have the same operating problems as banks. They retain a large measure of personal contact with their customers and do not have the branch control problem of some banks. For

these reasons, the benefits scoring can give are of less importance to the credit unions than to banks.

The average length of use of scoring was slightly under six years, with a range of from less than one to ten years.

From the small number of those using credit scoring, improvement in operations was reported. Three out of the five credit unions experienced concrete evidence of improvement in general, lower delinquency rates, and reduction of administrative costs. Two out of five had experienced lower loss ratios.

The two credit unions that did not have concrete evidence indicating improvement in operations did report that they had a general feeling that improvement had occurred. Two credit unions reported that scoring had resulted in a speed up of production and loan approval processes. The small sample size of those using scoring does not permit drawing any firm conclusions regarding credit union performance when using scoring. It can be pointed out however, that all users did report some improvement in operations.

There were five credit unions which reported dropping scoring after once having tried a system. As in the case of the banks, this figure is important because it indicates that a significant number of institutions who try scoring eventually drop the concept.

The reasons for dropping scoring were not reported in all cases, but one firm dropped scoring because the average loan value had tripled over time. They felt that larger

loans needed more personal attention. Another firm which had used scoring for a limited number of loans subsequently abandoned the idea.

Several questionnaires elicited interesting general comments. One official reported that his office used a debt-to-income ratio which he felt indicated the applicant's paying ability. This figure coupled with other information was adequate for credit decisions. Another official, whose credit union served predominantly military personnel, sent back a lengthy summary of how his office arrived at credit decisions. He stated that all their loan officers were retired senior enlisted men who had ample credit experience. He emphasized that they know what to do and what not to do without need of guidelines or standards provided by scoring.

Another credit union official reported that his organization was considering a scoring system at present but that they were not sure that scoring would be beneficial. He reported that he doubted that a system could be devised that could, "protect us against the choir singer who runs off with the preacher, or the man who takes advantage of the very unfair bankruptcy laws to cancel his debts even though he is working steadily at a good wage and his total indebtedness is no great burden to him."

These general comments are of some significance and indicate diverse opinions of scoring by credit officials in the field. Even though credit literature is full of articles praising the scoring concept, it is apparent that not all

credit officials in decision-making positions necessarily agree with the literature.

D. SUMMARY

In Part III of this study many management uses of scoring were identified and several potential cost savings attributable to scoring were examined. These benefits were shown to far outweigh the disadvantages of scoring and appeared to indicate that the concept of scoring had potential for growth in the credit industry. However, results of the survey conducted as part of this study question this growth potential. Only 37% of the banks and 7% of the credit unions returning the questionnaires used the systems, which, for banks, is about the same percentage as in 1967. Furthermore, the percentage of banks considering using scoring is currently 11%, down from 33% in 1967. Finally, a trend that shows a significant percentage of institutions quitting scoring has been shown. These results would indicate that the credit scoring technique is, at least in the banking industry, in a period of stagnation. No comment regarding the growth potential of scoring in credit unions can be made because of the small number of current users and because no past studies of former usage were available. It must be pointed out that this survey deals only with the 100 largest banks and 100 largest federal credit unions. Finance companies, credit bureaus, and other consumer lenders, would also have to be queried in order to arrive at any meaningful appraisal of current usage and potential for growth of scoring.

VI. EFFECT ON SERVICEMEN

A. SYSTEM DESIGN TRADEOFFS

A scoring system that is specifically designed for a particular lending institution and tailored to the characteristics of the customers of that institution should be more effective than a system designed for the institution's industry as a whole. The degree of uniformity of the particular institution's customers can have an effect on the accuracy of the scoring system. An institution with branches in diverse geographic and economic areas or with diverse types of customers may need separate scoring systems for each area or type. An increase in the number of systems means an increase in design and maintenance costs. Of course there is also a limit to the value of information received by further stratification. Separate systems for plumbers, carpenters, and welders may not provide significantly more information toward determining good and bad loans than a single system for skilled workers. Therefore, lending institutions who have a system or systems designed specifically for their potential customers must make certain cost effective tradeoff decisions. Occasionally these decisions may adversely affect a certain segment of their potential customer population.

B. MILITARY CUSTOMERS

Occupation itself is usually not a very good discriminating characteristic of loan risk as was pointed out in Ref. 20.

For this reason, most credit scoring systems do not address occupation itself, but seek to determine those characteristics of the applicant that best discriminate between the good and bad risks. These characteristics have been aptly described subjectively as the three c's of credit -- character, capability, and collateral.

Character and capability are also referred to as stability and ability. The authors felt that there are certain aspects of the military service that prevent the serviceman from being scored fairly in these areas. Numerous questions relating to stability are frequently asked such as -- Do you own a home?, How long have you lived at your present address?, How long have you resided in this state?, Do you have a home phone?, etc. The serviceman may be living in government quarters. If he is single he may be living in the barracks or the Bachelor Officer Quarters. These men seldom have a phone other than the barracks or BOQ phone at the respective desks. If he is assigned to a ship his ship's phone is only available for outside usage during in-port periods. If the serviceman has lived at his present address for two years the chances are good that he is due for a new duty station shortly. It is not unreasonable to assume that at any particular point in a serviceman's career the answer to the question -- Have you lived at your present address more than two years? -- would be negative more often than not. These frequent moves are often out of state moves.

Seemingly easy questions regarding ability can be misleading when the potential loan customer is a serviceman. Even the question -- How much money do you make? -- can be a cloudy issue. When filling out the loan application the serviceman may not be able to provide an appropriate answer to that question. Even if he recalls the exact amount of his take home pay, there may be allotments automatically being taken out of his total pay for savings, loans, insurance, or miscellaneous purposes that he does not remember on the spot. The loan officer or the serviceman may have an up to date copy of the military pay scale to determine the base pay for his particular rate or rank and length of service. This figure, however, does not include various allowances for subsistence, quarters, hazardous duty pay, or any proficiency pay to which the serviceman may or may not be entitled. Even assuming that the correct pay figure has been determined, there is some question as to its validity in comparison to civilian pay. Recent efforts have been made to raise the earnings of the military serviceman to that of his civilian counterpart. Many of the military benefits do not equate directly to dollars earned. Increased benefits for the military man due to medical care, exchange, and commissary privileges may make the same pay figure for the serviceman and his civilian counterpart incomparable. Should not this hidden purchasing power of the military pay figure be taken into consideration by these credit scoring systems?

C. HYPOTHESIS

The purpose of this part of the thesis is to test the following hypothesis: "Since servicemen move more frequently than the population at large, often live in government quarters or rent instead of owning their own home, and receive much of their compensation as fringe benefits; they are not likely to be treated fairly by credit scoring systems". Certainly there are exceptions to the assumptions made by the authors. Many officers and senior enlisted personnel do own their own homes. Some personnel have been able to have prolonged tours of duty and different assignments in the same area. It is felt to be exceptional, however, for a serviceman to reside in the same home for more than three or four consecutive years.

Granting the above assumptions, the fact that servicemen score low in certain stability and ability areas is not conclusive evidence that they are not treated fairly by these consumer credit scoring systems. Servicemen may score high enough on other questions in these and other areas to counteract the low scoring questions. Thus, their overall score may be high enough to pass if it is a loan/no loan or credit/ no credit type decision. They are still penalized somewhat if the total score determines the absolute limit of credit available such as for a charge account or credit card.

D. SAMPLE

To test the hypothesis the authors drew a sample of loans made by the Monterey Peninsula Navy Federal Credit Union,

Monterey, California. This credit union, founded in 1968, has grown to over 6,000 members with total assets of over \$4½ million.

1. Good Loans

The sample consists of 100 good loans made for the purpose of purchasing new or used automobiles by active duty servicemen. The authors' rather strict definition of a "good loan" is that there has never been a late payment. These loans have either been successfully completed or were due for completion within a few months. The servicemen were predominantly Navy and Army personnel assigned to the Naval Postgraduate School, the Defense Language Institute, or Fort Ord. Officers comprised 41% of the 100 sample good loans. Of the 59% enlisted loans, 26% were of paygrades E1-E4 and 33% were E5 and above. These are reasonable stratification levels that can usually distinguish between first term and career enlisted personnel. Of the total 100 automobile loans 72% were for new cars and 28% for used cars.

2. Bad Loans

The sample also consists of 21 bad loans defined as those loans which have been delinquent for at least 60 days consecutively. This does not imply that these payments will not be made up or that the loan will not repay principal. Nine of the bad loans were for new cars (43% of the total), and twelve were for used cars (57% of the total). Of the 21 bad loan customers three or 14% were officers, nine or 43% were E1-E4, and nine or 43% were E5 and above. A larger

number of bad loans would have been desirable for the purposes of the survey. Only 21 loans met the criteria as "bad" that were for automobiles purchased by an active duty serviceman. To redefine bad loans as delinquency for 30 or 45 days would have severely lessened the differentiation between good and bad loans. It should be pointed out that automobile loans (especially when the cars themselves are used as collateral) are very safe types of loans. Household improvement, where the house may be collateral, is the only other type of loan that might be safer. These are the type of loan payments that people with financial problems will attempt to make first. Other types of consumer loans such as for furniture, vacation trips, and recreational vehicles will be the first to suffer. Since the car itself can provide adequate collateral and the customer is usually most unwilling to have it repossessed, automobile loans are among the easiest loans to obtain. The choice of automobile loans for the sample was made to assure an adequate degree of uniformity for comparison of other characteristics of the loan applicants.

3. Turndowns

To complete the sample the authors included 21 turn-downs. These were military personnel who applied for a loan by the local credit union for the purpose of purchasing a car but were refused the loans. Here the number twenty-one was strictly for convenience. Of the 21 turndowns four or 19% were for new cars and seventeen or 81% were for used cars. None of the turndowns were officers. Eighteen or 86% of them were E1-E4, and only three or 14% of them were E5 and above.

E. PROCEDURE

The scoring systems of three lending institutions, felt to be representative, were chosen to test each of the sample loan applicants. The information on the sample loan applications was sufficient to properly score each of the applicants on each of the three representative systems. Two of the systems are from large banks that do have branch operations located in the same geographic area as the sample loan applicants. The third lending institution is not located in the same geographic area as the applicants, but has a system that was specifically designed for a credit union with military members. To prevent the divulging of any competitive secrets the institutions shall be referred to as Bank X, Bank Y, and Credit Union A.

1. Bank X

Bank X employs a fairly formal scoring system. While it is possible that a customer with a lower than the set cutoff score may be granted the loan, it would be exceptional. Likewise it would be highly unlikely that a customer be denied a loan if he has a score exceeding the cutoff. There are three questions in this scoring system that the authors identified as potentially unfair for military personnel. On one of them, points are awarded if real estate is owned and no points are given for a negative answer. The others ask about the applicant's time at present address and time on job. If the previous job or previous address are not out of state, they may be included. Points are awarded on either of these questions if their respective times are two years or more.

The possible adverse effects on servicemen of the question regarding years on the job can be illustrated by the case of a sailor who has been in the Navy for, say, ten years. During this time he has probably had several moves and has had several billets on each of the different bases or ships to which he has been assigned. When asked the question -- "How long have you been on your present job?" -- he may well respond with one year, the time he has spent on his current billet as a metalsmith in the airframes division of the locally based aviation squadron. Or, he might respond with ten years, the time he has been employed by Uncle Sam. Clearly the ten year answer is more advantageous to the sailor, but he may not realize it. In this case it is not clear what answer the lending institution desires. If the sailor is puzzled as to the question's intent, he might ask the loan officer. Here, it is possible that the loan officer's interpretation of the question can vary from individual to individual. It could also vary from area to area depending on the number of military personnel stationed in the particular area and the individual lending institution's experience with, or preconceptions of, military customers.

It was of course impossible for the authors to attempt to evaluate the lending institution's intentions. This question was therefore scored for each of the sample applicants to the serviceman's favor with total time of continuous military active duty service. It is however, felt that the potentially discriminatory characteristics of the question is worthy of mention.

2. Bank Y

Bank Y's scoring system is somewhat more informal than X's. It states that its system is more of a guide to the loan officer. Attaining a good score does not prevent the loan officer from refusing the loan for his own reasons or observations. Likewise, it is conceivable that a person with a low score could still be granted the loan. A good example of this might be a young person just starting his career who had not had the opportunity to build up much credit experience. There are exceptions to the system, therefore, and it cannot be considered hardfast and automatic pass/fail.

The system is actually broken down into three sections. Questions in one section deal almost entirely with stability. The other sections deal with ability and a measure of the applicant's credit rating. The possible confusion regarding military pay as a measure of ability has previously been discussed. This scoring system did in fact recognize the increased purchasing power of military pay from fringe benefits. Actual military pay was increased by a factor of .25 to attempt to match the earning power of the serviceman to his civilian counterpart. The authors felt that this adequately covered any charge of discrimination in the ability section. Actually this factor may be overly favorable to the serviceman. Some of the increased purchasing power of military pay due to fringe benefits may actually be offset by other increased incidental expenses caused by frequent moves, uniform upkeep, etc.

The ability score is determined on an income to outgo basis. Since the serviceman's income was adjusted upward by the .25 factor, the usage of this section of the system was not questioned. If a serviceman has a poor income to outgo ratio he is just as bad a credit risk as a civilian with the same ratio. Especially so in this case, where the serviceman's income figure has been adjusted.

The same logic holds true for the section dealing with the applicant's previous credit rating. Here, Bank Y utilized external investigative information of various degrees to determine the previous credit rating of the applicant. A poor credit rating is equally bad for a serviceman or a civilian. Obviously, the authors did not conduct a post facto credit investigation on each of the sample loan applicants. Since the assumption was made that there was no obvious evidence of discrimination in this area, all of the loans were scored in favor of the servicemen. A bad credit rating in this area results in the subtraction of points from the total score. No points were deducted in this area. Thus it is entirely possible that if Bank Y had actually scored the applicants, more of the loans would have been rejected than the sample results indicate.

The stability section of this system includes questions that can be potentially unfair to the serviceman. In particular these questions are whether or not you own or are buying a home, and whether or not you have a home telephone in your own name. This system avoids the "how long on present

job" possible confusion by phrasing the question, "How long have you been currently employed?" Once again, regardless of possible confusion the authors scored this question in favor of the serviceman and gave each applicant credit for his total time on continuous active duty.

3. Credit Union A

If the discrimination hypothesis is true we would expect that military members would fare better on the system designed specifically for the serviceman than on the two civilian systems. This is especially true since this system does not ask if you rent a home or how long you have lived at your present address. It asks for a telephone, but it does not have to be an account in your own name. Giving the ship's duty phone or the barracks phone is ample evidence for them that you are not attempting to evade being located in the future. It is admittedly a better indication of good credit to have passed the telephone company's hurdle of being accepted as a customer. This is however, quite impractical for someone living on a ship or in the barracks.

The sample of 100 good loans, 21 bad loans, and 21 turndowns was each scored on Bank X, Bank Y, and Credit Union A systems. Particular attention in the analysis will be placed on those questions of Bank X and Bank Y previously earmarked, i.e., years at present address and ownership of real estate for Bank X, and home telephone and home ownership for Bank Y.

F. RESULTS

1. Bank X

The Bank X scoring system failed 13 of the 100 good loans. It also failed ten of the 21 bad loans and 15 of the 21 turndowns.

a. Good Loans

Of the 13 good loans turned down 23% were for used cars and 77% were for new cars which very closely approximates the 100 good loan sample of 72% new and 28% used cars. Also of the same 13 good loans that failed, six were E1-E4, three were E5 and above, and four were officers.

<u>Category</u>	<u>Initial #</u>	<u># of good that failed</u>	<u>% of good loan sample that failed</u>
new	72	10	10%
used	<u>28</u>	<u>3</u>	<u>3%</u>
	100	13	13%
<hr/>			
E1-E4	26	6	6%
E5-up	33	3	3%
Officers	<u>41</u>	<u>4</u>	<u>4%</u>
	100	13	13%

The largest percentage of good loans that failed belonged to the E1-E4 category which was the smallest percentage of the initial 100 good loan sample.

b. Bad Loans

<u>Category</u>	<u>Initial #</u>	<u>Initial % of bad loans</u>	<u># of bad that failed</u>	<u>% of bad loan sample that failed</u>
new	9	43%	3	14%
used	<u>12</u>	<u>57%</u>	<u>7</u>	<u>33%</u>
	21	100%	10	47%
<hr/>				
E1-E4	9	43%	7	33%
E5-up	9	43%	2	9%
Officers	<u>3</u>	<u>14%</u>	<u>1</u>	<u>5%</u>
	21	100%	10	47%

The majority of the bad seven out of ten that the Bank X system earmarked as bad loans were located in the E1-E4 category.

c. Turndowns

<u>Category</u>	<u>Initial # of turndowns</u>	<u>Initial % of turndowns</u>	<u># of turndowns that failed</u>	<u>% of sample turndowns that failed</u>
new	4	19%	3	14%
used	<u>17</u>	<u>81%</u>	<u>12</u>	<u>57%</u>
	21	100%	15	71%
<hr/>				
E1-E4	18	86%	12	57%
E5-up	3	14%	3	14%
Officers	<u>0</u>	<u>-</u>	<u>0</u>	<u>-</u>
	21	100%	15	71%

2. Bank Y

Bank Y rejected 20 of the 100 good loans, 13 of 21 or 62% of the bad loans, and 20 of 21 or 95% of the turndowns. Although failure in any one of the three sections of this system (stability, ability, total score after credit rating) results in rejection, only stability and ability will be examined. Since none of the total scores were lowered for credit rating in the sample, it was impossible for an applicant to pass both the stability and ability sections and simultaneously fail the total score section. All rejections are therefore included in the combination of the stability and ability sections.

a. Good Loans

Of the 20 good loans that were rejected 14 failed for stability and six for ability. There were none that failed both sections.

<u>Category</u>	<u># in initial sample</u>	<u># of good failed for stability</u>	<u># of good failed for ability</u>
new	72	6	6
used	<u>28</u>	<u>8</u>	<u>0</u>
	100	14	6
<hr/>			
E1-E4	26	12	3
E5-up	33	2	1
Officers	<u>41</u>	<u>0</u>	<u>2</u>
	100	14	6

Here again as in Bank X the largest number of good loans that failed (15 of 20 or 75%) were in the E1-E4 category which actually comprised only 26% of the 100 good loan sample.

b. Bad Loans

Bank Y rejected 13 of the 21 bad loans or 69%. Ten failed the stability section and eight failed for ability. There were five that failed both stability and ability.

<u>Category</u>	<u># initial</u>	<u>% initial</u>	<u># of bad failed for stability</u>	<u>%</u>	<u># of bad failed for ability</u>	<u>%</u>
new	9	43%	2	10%	3	14%
used	<u>12</u>	<u>57%</u>	<u>8</u>	<u>38%</u>	<u>5</u>	<u>24%</u>
	21	100%	10	48%	8	38%
<hr/>						
E1-E4	9	43%	9	43%	5	24%
E5-up	9	43%	1	5%	2	10%
Officers	<u>3</u>	<u>14%</u>	<u>0</u>	<u>-</u>	<u>1</u>	<u>4%</u>
	21	100%	10	48%	8	38%

Of the five rejections that failed both the stability and the ability sections, one was for a new car and the other four were for used cars. All five were in the E1-E4 category. Therefore, nine of the 13 or 69% of the bad loans rejected were in this category which comprised 43% of the bad loan sample.

c. Turndowns

Bank Y rejected 20 of the 21 turndowns. Eighteen failed for stability and four for ability including two which failed both.

<u>Category</u>	<u># initial</u>	<u>% initial</u>	<u># failed stability</u>	<u>%</u>	<u># failed ability</u>	<u>%</u>
new	4	19%	2	10%	3	14%
used	<u>17</u>	<u>81%</u>	<u>16</u>	<u>76%</u>	<u>1</u>	<u>5%</u>
	21	100%	18	86%	4	19%
<hr/>						
E1-E4	18	86%	18	86%	2	9½%
E5-up	3	14%	0	-	2	9½%
Officers	<u>0</u>	<u>-</u>	<u>0</u>	<u>-</u>	<u>0</u>	<u>-</u>
	21	100%	18	86%	4	19%

3. Credit Union A

Credit Union A rejected five of the 100 sample good loans, four of the 21 or 19% of the bad loans, and 10 of the 21 or 48% of the turndowns. All of the rejections in each of the three sample areas were for used cars and were in the E1-E4 category.

a. Good Loans

<u>Category</u>	<u># initial</u>	<u># of good that failed</u>
new	72	0
used	<u>28</u>	<u>5</u>
	100	5
<hr/>		
E1-E4	26	5
E5-up	33	0
Officers	<u>41</u>	<u>0</u>
	100	5

b. Bad Loans

<u>Category</u>	<u># initial</u>	<u>% initial</u>	<u># of bad that failed</u>	<u>% of initial</u>
new	9	43%	0	-
used	<u>12</u>	<u>57%</u>	<u>4</u>	<u>19%</u>
	21	100%	4	19%
<hr/>				
E1-E4	9	43%	4	19%
E5-up	9	43%	0	-
Officers	<u>3</u>	<u>14%</u>	<u>0</u>	<u>-</u>
	21	100%	4	19%

c. Turndowns

<u>Category</u>	<u># initial</u>	<u>% initial</u>	<u># of bad loans</u>	<u>% of initial</u>
new	4	19%	0	-
used	<u>17</u>	<u>81%</u>	<u>10</u>	<u>48%</u>
	21	100%	10	48%
<hr/>				
E1-E4	18	86%	10	48%
E5-up	3	14%	0	-
Officers	<u>0</u>	<u>-</u>	<u>0</u>	<u>-</u>
	21	100%	10	48%

G. ANALYSIS

The following table is a summary of the number and percentage of rejections in each of the three sample categories as pertaining to each lending institution. The Bank Y statistics pertain to the stability section of its scoring system.

	<u>Good loans rejected</u>		<u>Bad loans rejected</u>		<u>Turndowns rejected</u>	
	<u>#</u>	<u>%</u>	<u>#</u>	<u>%</u>	<u>#</u>	<u>%</u>
Bank X	13	13%	10	48%	15	71%
Bank Y	14	14%	10	48%	18	86%
Credit Union A	5	5%	4	19%	10	48%

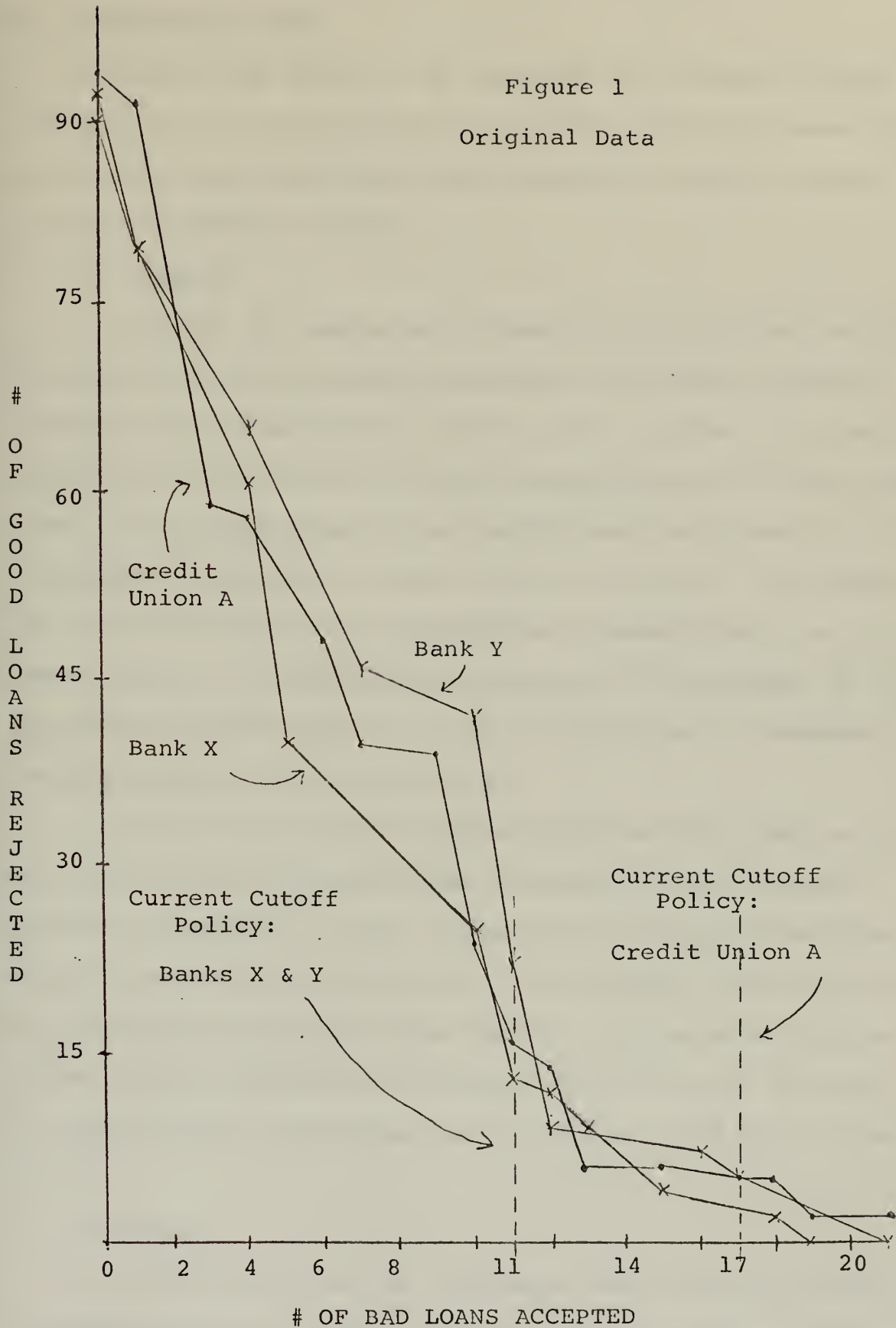
It can be seen that Credit Union A clearly rejects the fewest of the good loans. It also rejects the least, thus accepting the most of the bad loans and the turndowns. When evaluating scoring systems, it is not enough to consider only the number of good loans accepted. Attention must also be given to the number of bad loans accepted.

The increase in the number of bad loans accepted subtracts from the gain received from accepting more good loans. No system can be expected to perfectly pick out all the good and all the bad loans. Each of these institutions choose their particular cutoff points with the expectations of maximizing their return. Having a system that would absolutely refuse all bad loans would ordinarily result in a lowering of total profit because many marginal applicants that turn out as profitable business would be lost. The setting of each institution's cutoff is dependent on management policy as well as their estimated individual loan margin and overhead costs of bad loans.

Figure 1 is an attempt to show the discriminating power (ability to distinguish good from bad risks) of each of the systems. The cutoff scores that gave each of the systems a particular number of bad loans accepted was related to the number of good loans rejected for that same cutoff score. Thus, the systems can be compared considering the overall effect of lessening good loans rejection with the accompanying increase of bad loans acceptance.

It appears from figure 1 that Bank X dominates with a lower number of good loans rejected for most all numbers of bad loans accepted. Therefore, although Credit Union A's cutoff is chosen so that it accepts most of the good loans, it also accepts most of the bad loans. Bank X actually does the best job of distinguishing the good from the bad loans of the sample.

Figure 1
Original Data



H. SENSITIVITY TESTS

A closer look needs to be taken of the systems of Bank X and Bank Y as to the possibility of the particular questions previously identified being discriminatory and thus influencing the overall results.

1. Bank X

Of the 100 sample good loans only 30 received points for living at their present addresses (including previous address, if in same state) for two years or more. Of the 13 good loans that failed only one received points for this question. If another question was substituted that gave all of the military personnel credit for this question, the number of 100 good loans that fail would be reduced from 13 to 8. There would be a corresponding increase in the number of 21 bad loans accepted from 11 to 13. Acceptance of turndowns would increase from 6 to 12 of 21.

Only 29 of the 100 sample good loans received points for the question concerning the ownership of real estate (whether mortgaged or not). None of the 13 good loans that failed received any credit here. If they had, only four of the 100 good loans would have failed. Correspondently, bad loans accepted would have increased from 11 of 21 to 15 of 21 and turndowns acceptance would increase from 6 to 12 out of 21.

2. Bank Y

Seventy-nine of the 100 sample good loans received points for having a phone listed in their own name. Fifteen

of the 21 bad loans and six of the 21 turndowns also received points for this question. It would appear that this may be an appropriate question. A test was made to determine the effect of allowing a barracks or BOQ phone number. Only one of the 13 good loans that failed had received points for a phone. Seven others did have barracks phones listed on their applications and four of the seven had a sufficient score to pass with the inclusion of points from the barracks phone. The number of good loans that failed would thus be reduced from 13 to 9 of the 100 good loans. Bad loans accepted would have increased by one and turndowns accepted would stay the same at three of 21.

Only 24 of the 100 sample good loans received points for owning a home. None of the 13 good loans that failed received any points for this question. If value (question's weight depended on equity in the home) was given which corresponded to a minimum of 10% equity, only six of the 100 good loans would have failed. Bad loans accepted would have increased from 11 to 16 of 21 and turndowns accepted from three to six.

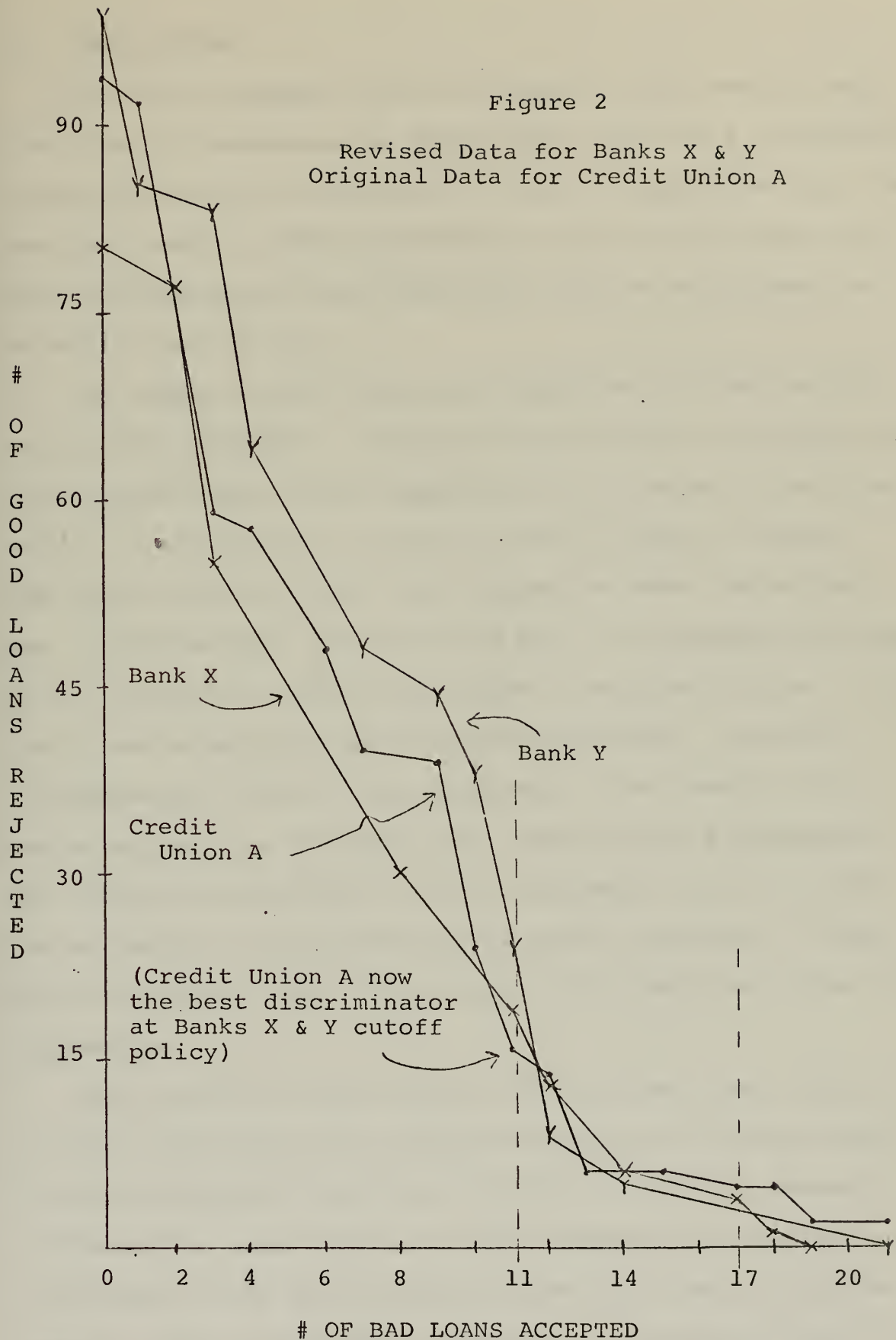
3. Overall Test

As with figure 1, figure 2 is a test of the three systems overall discriminating ability. This time the systems are calculated without the possibly discriminating questions of Bank X and Bank Y.

Bank X no longer clearly dominates as the best discriminator.

Figure 2

Revised Data for Banks X & Y
Original Data for Credit Union A



I. CONCLUSIONS

All of the systems appear to point at the used car and the E1 to E4 categories as being high risk with a correspondingly low chance of acceptance. This is reasonable since the used car does not offer collateral comparable to a new car, and E1-E4 personnel have had little time to build proof of stability and ability.

The sample results have not conclusively proved or disproved the hypothesis. Although Credit Union A accepted more of the good loans, Bank X appeared to be the more discriminating. In addition to the size of the 21 bad loan sample, the discrimination tests were subject to some limitations due to the authors' definition of bad. A sixty-day delinquent loan is probably a good money-maker. Only one of the 21 bad loans was actually an uncollectable write-off. Even the turndowns may not be a fair indicator. The sample credit union may be very conservative. Credit Union A appears to be far from conservative. It is reasonable for the credit union, which is more service than profit oriented, to look more favorably on their own members and accept more risk than the banks.

The findings of this study will not prompt any civilian lending institution into restructuring their scoring system for the prospective military customer. It could, however, influence the loan officer to make exceptions to borderline situations if the serviceman has provided a barracks phone number, lives in government quarters, or has been forced to move frequently due to changes of duty station.

This study should also be of considerable value to the serviceman applying for a loan. Questions as to time on job or pay should be answered truthfully, but to his advantage. If he does fail, it may be worthwhile to call the accompanying unstable characteristics of the military service to the loan officer's attention for possible reconsideration.

APPENDIX A

CREDIT EVALUATION WORK SHEET

CUSTOMER'S NAME	_____	DATE	_____
ADDRESS	_____	APPROVED BY	_____
CITY & STATE	_____	AMOUNT	_____
		REJECTED BY	_____

CREDIT EVALUATION			CUSTOMER SCORE
A. AGE	21 yrs.-25 yrs.	1	
	26 yrs.-30 yrs.	3	
	31 yrs.-60 yrs.	5	
B. MARITAL STATUS			
C. RESIDENCE	Board	1	
	Rent	4	
	Own	8	
D. LENGTH AT RESIDENCE	0 to 6 months	1	
	6 mos. to 3 yrs.	5	
	3 yrs. and over	10	
E. OCCUPATION	Class A	25	
	Class B	15	
	Class C	8	
	Class D	3	
F. LENGTH OF EMPLOYMENT	0 to 6 months	1	
	6 mos. to 3 yrs.	8	
	3 yrs. and over	15	
G. MONTHLY INCOME	\$225 to \$299	5	
	\$300 to \$399	10	
	\$400 to \$650	15	
H. BANK ACCT.	Checking	1	
	Saving	2	
TOTAL POINTS			

If credit evaluation score is 40 or under, the customer must be considered a poor risk and should be rejected.

If credit evaluation score is between 41 and 65, customer can be sold but good judgment must be used on amount.

If credit evaluation score is 66 or higher, and all other qualifications have been met, customer can be considered a good risk and appropriate amount extended.

APPENDIX B
NAVAL POSTGRADUATE SCHOOL

MONTEREY, CALIFORNIA - 93940

IN REPLY REFER TO:

NC4(36)/ec
2700

15 AUG 1973

Dear Sir:

Two students in the Financial Management Curriculum at this school are writing a master's thesis on the subject of consumer credit. As part of their thesis they are evaluating scoring systems used by financial institutions in granting loans.

Lieutenant Commander T. L. Johnson, SC, USN, and Lieutenant Commander W. S. Wojtkowski, USN, have designed the enclosed questionnaire in order to sample some of the larger lenders in their use of scoring systems. Specifically, they hope to trace the widespread use of scoring systems as consumer credit has grown in the last 40 years. Additionally, they hope to analyze several scoring systems as they affect members of the Naval service.

While insisting on selection and pursuit of meaningful thesis projects by advanced degree candidates, the Postgraduate School does not desire to impose an administrative burden on any other activity. However, response to the subject questionnaire may provide a significant contribution to the study of consumer lending techniques.

Replies to the questionnaire will be used only for the purpose of this research and will not be specifically identifiable within the thesis. It is requested that the questionnaire be returned directly to the students.

The work being done by the two students is purely academic in nature. The questionnaires will be destroyed upon thesis publication.

Any additional information or comment you may have that you feel would be meaningful to this thesis project is requested and encouraged. Any questions regarding the questionnaire should be addressed to LCDR T. L. Johnson or LCDR W. S. Wojtkowski at telephone number 408-646-2536 and/or by writing to them at Student Mail Center, Box 2297, Naval Postgraduate School, Monterey, California 93940.

Thank you for your time and consideration in this matter.

Sincerely yours,



D. W. KILEY
Captain, U. S. Navy
Director of Programs
By direction of the Superintendent

SURVEY

The purpose of this survey is to gain data regarding scoring systems used in granting consumer credit. To illustrate, using a scoring system a loan applicant's characteristics are measured based on information about him that appears on the loan application blank. A single numerical score is computed which indicates to the loan officer a possible course of action (i.e., grant the loan, seek further information, or turn down the loan).

The above should be kept in mind when filling out the questions below.

1. When reviewing consumer loan applications, does your firm utilize a numerical scoring system which gives a single score based on the applicant's characteristics?

YES _____ (if yes, please advance to question 4)

NO _____

2. Has your firm ever used such a system in the past?

YES _____

NO _____

3. Is your firm presently considering such a system?

YES _____

NO _____

THANK YOU FOR YOUR COOPERATION. YOU NEED NOT PROCEED FURTHER.

4. Do you utilize the scoring system for the following types of loans:

<u>LOAN</u>	<u>YES</u>	<u>NO</u>
Direct Auto	_____	_____
Indirect Auto	_____	_____
Household Improvement	_____	_____
Personal Loans	_____	_____
Other Type (if yes, please specify type i.e., RV, boat, aircraft, etc.)	_____	_____

5. With the use of your scoring system, have you any evidence of improved operation?

_____ Yes, we have evidence of improved operation in the following areas: (please check appropriate areas)

_____ loss ratios

_____ delinquency rates

_____ administrative loan costs

_____ other (please specify below)

_____ Although we have not accumulated concrete evidence, we do feel that the scoring system has aided our operation.

_____ No evidence of improvement exists.

6. How long have you been using a numerical scoring system?

THANK YOU FOR YOUR COOPERATION

LIST OF REFERENCES

1. Federal Reserve Bulletin, Table A54, June 1973.
2. Glasser, Gerald J., "Statistical and Mathematical Applications in Consumer Credit Management," part 1, The Credit World, p. 18-21, October 1966.
3. Cohen, K. J., and Hammer, F. S., Analytical Methods in Banking, Irwin, 1966.
4. National Retail Furniture Association Special Report, How Scoring Systems Take the Guesswork Out of Granting Credit, May 1969.
5. Durand, David, Risk Elements in Consumer Installment Financing, Study no. 8 (New York: National Bureau of Economic Research, 1941).
6. Wolbers, H. L., The Use of the Biographical Data Blank in Predicting Good and Potentially Poor Credit Risks, unpublished M.A. Thesis, University of Southern California, 1949.
7. McGrath, J. J., "Improving Credit Evaluation with a Weighted Application Blank," Journal of Applied Psychology, v. 44, p. 325-328, October 1960.
8. Zaegel, R. J., "After 10 Years of Credit Scoring," The Credit World, p. 14-16, July 1971.
9. Presby, J. T., and Simon, S. R., "Credit Scoring Can Save Money and Improve Credit Granting Too," Stores, p. 17-18, October 1969.
10. American Investment Company report Credit Scoring Announcement by D. L. Barnes, p. 3, 6 June 1961.
11. Boggess, W. P., "Screen Test Your Credit Risks," Harvard Business Review, p. 113-122, November-December 1967.
12. Biborosch, R. A., "Numerical Credit Scoring," Part 1, The Credit World, p. 6-9, June 1965.
13. Biborosch, R. A., "Numerical Credit Scoring," Part 2, The Credit World, p. 16-17, July 1965.
14. Johnson, N., "How Point Scoring Can Do More Than Help Make Loan Decisions," Banking, p. 41, August 1971.
15. Coakley, W. D., "Small Loan Credit Scoring," Industrial Banker, p. 12-14, February 1971.

16. Wilt, G. A., Jr., and Tierney, J. M., Jr., "Progressive Risk Analysis Through Credit Scoring," The Credit World, p. 10-11, March 1968.
17. Roy, J. H., and Lewis, E. M., "Overcoming Obstacles in Using Credit Scoring Systems," The Credit World, p. 16-18, June 1970.
18. "Installment Credit," Bankers Research, p. 1, 9 December 1971.
19. Roy, H. J., "Breakthroughs in Credit Scoring," Stores, p. 13, June 1973.
20. Cole, R. H., "Doctor, Lawyer, Indian Chief," ACBofA Management, p. 16-17, June 1967.

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number) The four objectives addressed were the description of credit scoring development, the identification of management uses and attendant disadvantages of scoring, an evaluation of the current and potential uses of scoring in banks and credit unions, and the determination of whether military servicemen are adversely affected by scoring.		

The conclusions reached were that the advantages of scoring appear to especially outweigh the disadvantages for large volume lending institutions with access to computers. A survey of the country's 100 largest banks and 100 largest federal credit unions indicated an apparent slowing of scoring growth. A sample of automobile loans of active duty servicemen scored on the systems of two commercial banks and one credit union provided limited evidence that servicemen are not treated fairly by credit scoring.

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